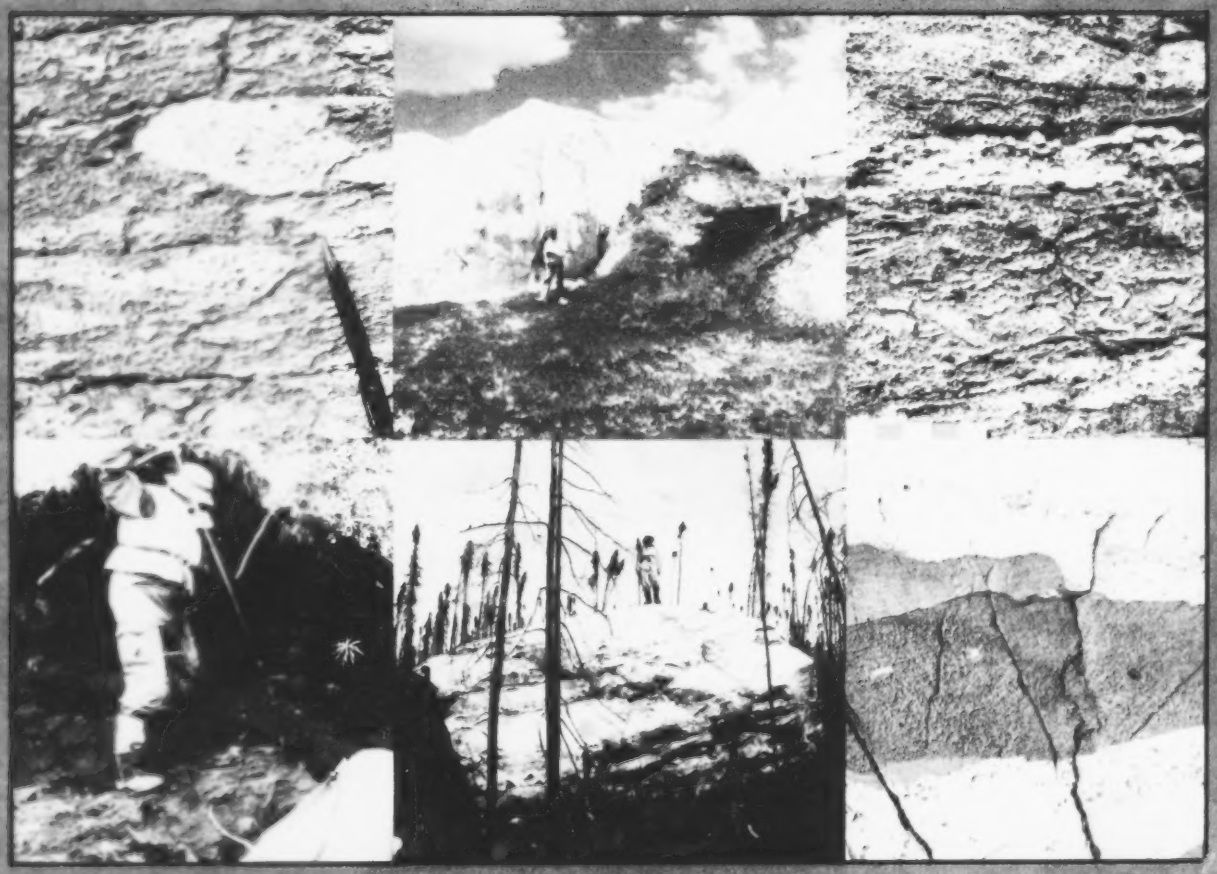
Saskatchewan Industry and Resources

November 27 to 29, 2006

Open House 2006

Abstract Volume

Saskatchewan Geological Survey



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Cover (clockwise from upper left):
Silicified scoriaceous basalt breccia, Douglas Lake area, Creighton, Saskatchewan (see MacLachlan, this volume).
Whitemud Formation, Gollier Creek deposit, site of Whitemud Resources meta-kaolin project (see Kelley, this volume).
Centimetre-scale blades of kyanite in a matrix of cordierite and biotite, north part of Warren Bay, west Charcoal Lake (see Card *et al.*, this volume)
Lamprophyre dyke cutting across an older phase of lamprophyre, which in turn intruded garnetiferous leucogranite; from northeast corner of Neil Bay, Fond-du-Lac Project (see Ashton *et al.*, this volume)
Very large glacially transported erratics are common in the Cochrane River area, north of Wollaston Lake; geological assistant, Christine Austman, stands atop the 10 m x 10 m x 5 m high erratic (see Smith, this volume).
Peat outcrop on Charcoal Lake (see Smith, this volume).
All photos have been taken by staff of Saskatchewan Industry and Resources.

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Regina, SK S4P 2H9
(306) 787-2528
FAX: (306) 787-2488
E-mail: publications@ir.gov.sk.ca

Editor:
G.D. Delaney

Production Editor:
C.L. Brown

Production Assistant:
M. Otterson

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Technical Session 1:
Uranium, Mineral Activity Overview, and Consultation

The Structural Setting of Rocks Near the Wollaston-Mudjatik Domain Boundary: A Perspective Based on the Northeast Wollaston Mapping Project

C. Card [1], C.T. Harper [1], J. Lesperance [2], and N. Barsi [3]

Abstract

The Wollaston-Mudjatik transition zone hosts the McArthur River and Cigar Lake deposits, the largest high-grade uranium deposits in the world, a number of smaller deposits, including Rabbit Lake/Eagle Point, McLean Lake, Midwest and Millennium, and the exhausted Key Lake deposits. These deposits account for the majority of Saskatchewan's historic, current, and near-future uranium production. The deposits are hosted in a 20 to 30 km-wide belt that runs parallel to the northeast grain of the Trans-Hudson Orogen, and are generally closely associated with the contact between Archean granitoid rocks and graphitic pelites of the basal part of the Paleoproterozoic Wollaston Supergroup.

The northeast Wollaston mapping project has identified two distinct successions of Wollaston Supergroup. The east parts of the transects are dominated by psammite, calcareous psammite, calc-silicate rocks, and some graphitic pelite. Basement lithologies are rare. In contrast, the western parts are dominated by basement lithologies coring overturned domes mantled by basal lithologies of the Wollaston Supergroup, including graphitic pelite and psammopelite. These two sub-domains are separated along a northeast-trending discontinuity, interpreted to have formed by shearing along the limb of a northeast-trending F_3 fold.

The boundary between domains was originally defined as the transition from elongate or "linear" folds in the Wollaston to upright and symmetrical domes and basins in the Mudjatik, a line that loosely corresponded to the disappearance of Wollaston Supergroup rocks. The earliest workers suggested that there was no evidence that supported a discontinuity between the domains. It was later suggested, however, that there is a structural discontinuity between the domains that likely represented a tectonic front related to the Trans-Hudson Orogeny. Our mapping across the domain boundary, as well as mapping along other transects, has yielded no evidence to support a tectonic discontinuity between the domains. Early mylonite zones, similar in interpreted age to the proposed tectonic front, were documented, but can be traced around the hinges of F_3 folds, which are thought to have developed after the peak of Trans-Hudson orogenesis. Steep, east-northeast– and northeast-trending shear zones clearly cut the limbs and hinges of F_3 folds and were therefore formed either synchronous with, or subsequent to, the folds. It is these shear zones, interpreted to have developed within a dextral stress regime, that have the potential to be crustal penetrative. Although common across the region, the shear zones seem to be best developed in the Wollaston-Mudjatik transition zone.

The key features of the Wollaston-Mudjatik transition zone appear to be an abrupt increase of proportion of basal Wollaston lithologies and basement across an intradomainal discontinuity and the development of numerous steep shear zones on the limbs and noses of F_3 folds. The location of the shear zones was apparently controlled by the geometry of the folds and the contact between the basal Wollaston graphitic pelite unit and basement rocks. The development of the shear zones in the graphitic lithologies satisfied one of the conditions necessary for the development of unconformity uranium deposits beneath the Athabasca Basin.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Department of Geological Sciences, University of Saskatchewan, 114 Science Place, Saskatoon, SK S7N 5E2.
[3] Department of Geology, University of Regina, 3737 Wascana Parkway, Regina, SK S4S 0A2.

The Mae Zone: Recent Work on the Midwest Project

K. Wheatley [1]

Abstract

Abstract unavailable at time of printing.

[1] AREVA Resources Canada Inc., P.O. Box 9204, 817 - 45th Street West, Saskatoon, SK S7K 3X5.

Collins Creek – Geological Setting of a Classic Athabasca Unconformity Deposit

D. Hirsekorn [1]

Abstract

The Collins Creek deposit is a classic unconformity-type uranium deposit located near the eastern edge of the Athabasca Basin in northern Saskatchewan, approximately halfway between the McClean Lake and Midwest Lake deposits. The deposit occurs on the Dawn Lake Project, a joint venture among Cameco Corporation – Operator (57.466%), AREVA Resources Canada Inc. (23.086%), and JCU (Canada) Exploration Co. Ltd. (19.448%). The Dawn Lake project has been active since 1976, with the Collins Creek deposit discovered in 1999. The deposit area was intermittently worked until 2005, when a more focussed drilling program confirmed and extended the mineralization on the eastern portion of the deposit. Recent drilling has continued to extend mineralization, with mineralized intercepts now encountered over 600 m along strike. The deposit occurs at 180 to 190 m depth at the unconformity between quartz arenite sandstones of the basal Athabasca Group and the underlying metasedimentary basement rocks of the western Wollaston Domain. Basement lithologies intersected by drilling in the Collins Creek deposit comprise an east-northeast–trending, moderate south-southeast–dipping sequence of variably graphitic biotite-quartz-feldspar gneisses and multiple calc-silicate–bearing units. The area is structurally complex. The dominant structural control on mineralization is a wide zone of semi-brittle deformation consisting of multiple fault strands hosted within moderately to strongly graphitic pelites. Elements of this distributed fault zone exhibit post-sandstone brittle reactivations. The deposit exhibits zoned hydrothermal alteration consisting of a "brick-red" hematite cap, interpreted to be related to oxidizing fluids conditions, cored by grey pyritic/marcasitic, and chloritic alterations interpreted to represent more reducing fluid conditions. The two alteration packages, oxidizing and reducing, commonly occur in a complex series of overlapping relationships intimate with the mineralization. The mineralization is generally polymetallic in character, occurring as pitchblende and uraninite associated with sulphides and nickel-cobalt-arsenides. Niccolite, pyrite, galena, and chalcopyrite are all visibly associated with the uranium mineralization. The lower-grade "perched" sandstone-hosted mineralization in the deposit area often consists of small blebs and disseminations of pitchblende associated with oxidation/reduction boundaries. Perched mineralization can occur as much as 25 to 30 m above the main unconformity mineralization and is often interrupted by, or separated from, the main unconformity mineralization by a barren zone of relatively unmineralized sandstone. The main unconformity-hosted mineralization is strongly controlled by the presence of the moderately to strongly graphitic pelitic gneisses that host the semi-brittle basement fault zone. The mineralization itself occurs as millimetre-scale blebs, higher-grade irregular replacements, "worm-rock" texture replacements, and more rare centimetre-scale veins of pitchblende and uraninite. Grades in the deposit range from 0.1% to as high as 56% U_3O_8 over narrow intervals, with typical grades in the 2 to 5% range. The best intersection drilled to date returned 18.3% eU_3O_8 over 8.9 m in drill hole Q8-125.

[1] Cameco Corporation, 2121 - 11th Street West, Saskatoon, SK S7M 1J3

The Centennial Zone – Geological Setting, Exploration History, and Mineralization

D. Jiricka [1]

Abstract

The Centennial Zone is located in the south-central portion of the Athabasca Basin in northern Saskatchewan, approximately 310 km northwest of La Ronge (see Figure). The Virgin River project, which contains the Centennial Zone, is a joint venture between UEM (98%), equally owned by Cameco Corporation (the project operator) and AREVA Resources Canada Ltd. and Formation Capital Corporation's wholly owned Canadian subsidiary, Coronation Mines Limited (2%).

The Centennial Zone occurs within an area underlain by approximately 750 to 1000 m of Paleoproterozoic-aged Athabasca Group rocks, which, in turn, are underlain by a prominent belt of Aphebian to Archean-aged mylonitized rocks of the Snowbird Tectonic Zone. The Snowbird Tectonic Zone or Virgin River Trend (VRT), as it is referred to by Cameco staff, is a major "crustal-scale" structural discontinuity that forms the boundary between the Hearne Province (Virgin River Domain) to the east and the Rae Province (Lloyd Domain) to the west. Post-Athabasca Group reactivation along mylonitized rocks of the VRT, is manifested in the Dufferin Fault, a reverse fault displaying greater than 250 m vertical displacement of the Athabasca Group unconformity.

Data from government and industry sponsored geophysical surveys near the Centennial Zone indicate that it occurs along the eastern edge of sublinear magnetic low and gravity high and within a "corridor" containing numerous electromagnetic conductor systems.

The exploration history of the Virgin River project is comparatively short, having been initiated by UEM in 1992 as a "grassroots play". Significant exploration "milestones" of the exploration history of the area include:

1) *Identification of the post-Athabasca Group Dufferin Lake fault and associated alteration by UEM in the area to the south (1978-1982).*
2) *Area selection of the Virgin River project by UEM (1992-1995).*
3) *The initial application of deeper penetrating TEM surveys and the identification of EM conductors (most notably the "C" conductor) along the VRT and in the footwall of the Dufferin Fault by UEM (1986-1998).*
4) *Application of complementary Moving Loop TEM and longitudinal resistivity surveys supported by existing drill core review and geochemistry along the "C" conductor by Cameco (1999 to date).*

During the summer of 2004, diamond drill hole VR-18 tested a Moving Loop EM conductor and cross-cutting resistivity low in the footwall of the Dufferin Fault, resulting in the discovery of the Centennial Zone beneath 789 m of Athabasca Group cover rock. This uranium intersection, along with others obtained in subsequent programs, were named in honour of the Province of Saskatchewan's 100th anniversary.

Diamond drilling to date has yielded a total of nine[2] significant uranium intersections (out of 13 diamond drill holes completed) over a minimum strike length of 450 m (see Figure) and grade-thickness accumulations of up to 37.0 m% have been obtained. Significant uranium values have been obtained over appreciable widths (i.e., up to 8.40% U_3O_8 over 3.9 m including 25.6% U_3O_8 over 0.5 m in DDH VR-18W2), thereby demonstrating the potential for high-grade uranium mineralization in the Centennial Zone.

The Centennial Zone is considered to be a relatively typical example of unconformity-related uranium mineralization in the Athabasca Basin. Uranium mineralization occurs at or near the Athabasca Group unconformity, in the vicinity of the intersection between two distinct sets of faults; a moderately east-dipping fault set and a flat-lying fault set that is generally coincident with the Athabasca Group unconformity. Uranium mineralization consists of disseminated, vein, fracture-controlled, and massive pitchblende with only slightly elevated pathfinder element (Pb, Ni, Co, As, and B) contents. To date, the highest grade uranium intercepts have been hosted by altered basement rocks immediately beneath the unconformity.

---

[1] Cameco Corporation, 2121 - 11th Street West, Saskatoon, SK S7M 1J3.

[2] Check assays are still pending on four uraniferous intersections obtained during the 2006 drill program and public release of this information is pending.

Large-scale zones of Athabasca Group uranium enrichment, silicification, desilicification, chloritization, pyritization, kaolinization, dravitization, and brick-red hematization overlie the mineralization. Mineralization-related alteration in the basement rocks is restricted to the immediate vicinity of the Centennial Zone and consists primarily of chloritization, pyritization, dravitization, clay enrichment, and brick-red hematization.

Notably, no graphite has been intersected in the basement rocks in the vicinity of the Centennial Zone and the cause of the initially targeted Moving Loop EM conductor remains unknown. The actual location of graphitic basement rocks, which are known to be the cause of EM conductors elsewhere on the Virgin River project, are considered to be high priority targets for future exploration in this area.

The uranium intersections obtained in the Centennial Zone are the most significant ever encountered along the Virgin River Trend. The Centennial Zone remains open along strike to the northeast and is open across strike on all sections drilled. The joint venture has plans to continue significant exploration efforts to continue testing of the Virgin River project in the future.

Advances in Airborne EM: Issues of Breadth and Depth

K. Witherly [1] and R. Irvine [1]

Abstract

In the context of on-going exploration in the Athabasca Basin, EM techniques and specifically airborne EM are being called upon as the primary means to explore into the deeper parts of the Basin. Based upon results from a number of commercial systems (Witherly, 2005; Irvine and Witherly, 2006; Smith and Koch, 2006), current airborne EM technology has demonstrated the ability to detect large graphitic conductors to depths well in excess of 500 m. It is expected that conductors at 1 km or more have been located but await validation with drilling. The major caveat to achieving these depths is that there are no overlying conductors in the sandstone to impede the EM signal.

The detection of conductors at such ultra-depths (defined as >500 m), however, comes at a price and one casualty is spatial resolution. Due to the dispersive nature of EM fields, at depths of 500 m and more, the resulting anomalous responses are quite broad. Ground techniques used for follow-up also are affected by the same issue as airborne EM and, for a variety of reasons, may actually produce a result of lesser quality than the airborne data. This uncertainty in the geophysical outcomes then requires more drilling to adequately test such features as compared to conductors located at shallower depths. The possibility exists that with advanced modelling techniques, the actual geological source can be better.defined, but this is on-going research and development and a proven successful outcome has not been demonstrated.

The other improvement that explorers have wanted from airborne EM is to see an increase the breadth of the resistivity aperture as a number of deposits have shown to possess a resistive alteration system that extend well into the overlying sandstone. The resistivity of such alteration aureoles is typically beyond the normal range of airborne EM systems which were traditionally have been designed to map targets of low resistivity (i.e., massive sulphides). Although some existing airborne EM technology does an excellent job of mapping zones of high resistivity, the depth of investigation is limited to 100 m. Currently, the survey industry is experimenting with new technology that will have an increased depth of investigation and be able to provide enhanced sensitivity to zones of higher resistivity.

[1] Condor Consulting, 150 - 2201 Kipling Street, Lakewood, CO 80215.

TITAN-24 MT and DC-resistivity Survey Results over Shea Creek, Northwestern Saskatchewan – An Athabasca Sandstone-hosted Uranium Deposit

J. Legault [1]

Abstract

In early November 2005, Quantec undertook a TITAN distributed acquisition survey over the Shea Creek uranium showings in northwestern Saskatchewan. The Shea Creek showings, which include the Colette, Kianna, and Anne areas, occur in 700 m thick Athabasca sandstone above the unconformity and are associated with underlying basement graphites along the Saskatoon Lake conductive trend. The TITAN survey included joint DC-resistivity and IP acquisition with tensor magnetotelluric surveys, which were undertaken on two sets of test lines that overly the Saskatoon Lake Conductor trend and are immediately adjacent to the known showings.

TITAN-24 is a multi-channel, multi-parameter, distributed acquisition system, recording broad band Tensor magnetotelluric resistivity (AMT/MT), DC-resistivity, and induced polarization chargeability data. The TITAN system was developed by Quantec Geoscience with the help of industry partners Noranda Inc. and Barrick Inc. It has been applied in over 70 mineral exploration projects worldwide since 2000, but the Shea Creek study represents the first application of TITAN for Athabasca-type uranium exploration.

The TITAN-24 system consists of three main elements: 1) a 24 bit A/D digital acquisition system which uses a fixed, large-dipole, multi-channel receiver array; 2) a state-of-the-art digital signal processing platform; and 3) advanced 2-D–3-D interpretation capability, including geologically constrained inversions. Constrained inversions use a geologic model as a guide and a priori *model, whereas unconstrained geophysical inversions start from a half space. Inversion models are by their nature non-unique, offering many possible solutions. However, constrained inversions benefit by using a geologic model to limit the degrees of freedom and reducing the non-uniqueness problem. The result is often an improved model solution more readily accepted by geologists.*

The Shea Creek TITAN study employed 2-D synthetic MT and DCIP modelling and inversion in its initial survey design. The results predicted that TITAN pole-dipole array resistivity data would provide analogous results to the pole-pole array data currently employed. Modelling also predicted that chargeability might provide a useful parameter for detecting the alteration zones and underlying basement graphites. Modelling also suggested that superior lateral and vertical mapping information may be obtained from 2-D MT surveys when compared to similarly modelled DC-resistivity results. Field data for the most part replicated the results predicted in the synthetic modelling, particularly the MT. However, the DC and, in particular, the IP acquisition were hampered, in terms of data quality and penetration, by low injected currents caused by high resistivity overburden cover. The MT, DC-resistivity results appear to provide high resolution images of the subsurface that predominantly agree with the ground EM results with regards to known mineralized alteration zones and basement graphitic conductive trends. However, elsewhere, 3-D behaviour appears to add unexplained features in the inversion modelling results that require additional care and understanding of MT behaviour for its proper application for progressively deeper uranium deposits in the Athabasca basin.

[1] Quantec Geoscience Inc., Suite 400, 116 Spadina Avenue, Toronto, ON M5V 2K6.

Uranium: A New Inning

J. Reid [1]

Abstract

The true impact of the Cigar Lake flood has yet to be recognized within the capital markets. Though the initial hype has pushed uranium-based equities to all-time highs, the mid-term repercussions of this supply shortage will positively impact explorers and producers for at least the next three to four years.

The markets continue to advance, though capital is becoming more selective targeting those companies actively exploring or developing its respective assets and moving away from the speculative investment or those equities relying solely on historical data as the basis for its valuation.

The last twelve months have been marked by continued production disappointments from the major global producers and have seen the initiation of corporate consolidation within the global uranium sector.

The underlying fundamentals of uranium remain very strong and upward pressure to the commodity price can be expected. The focus of the presentation will be on the current state of/and drivers within the resource and specifically uranium equity markets, the reaction of the TSX to the continuing commodity boom and the relative performance geographically of those companies participating within this bull cycle.

The Athabasca Basin of northern Saskatchewan, which contains the largest, highest grade deposits in the world, remains elephant country for the explorer. Although a steady stream of recent exploration successes have been reported, it can be argued that, based upon the technical expertise required, the capital intensive nature of the exploration and the regulatory restrictions associated with advanced stage development, short-term value is harder to garner for the exploration company operating within the basin than those in other jurisdictions. The prize, however, is great in Saskatchewan. Although the provincial government is sensitive to and attempting to address issues related to regulatory overlap and duplication, the federal government has yet to pay more attention to these impediments to timely development of the province's uranium resources. The result of continued inaction by the regulators will be the loss of market share and capital investment to those jurisdictions where uranium development can be moved forward in a reasonable time frame.

[1] Sprott Securities Inc., Royal Bank Plaza South Tower, Suite 2750, Toronto, ON M5J 2J2.

A Tale of Two Basins – 2006: Mineral Exploration and Development Activity in Saskatchewan

P.L. Schwann [1]

Abstract

Abstract unavailable at time of printing.

[1] Mines Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9

The Duty to Consult with Aboriginal People – Saskatchewan's Response and the Impact on Industry

C. Talbot [1] and M. McAdam [1]

Abstract

The Supreme Court has recognized that governments have a duty to consult with Aboriginal people before undertaking any activity which might potentially interfere with the exercise of their existing Aboriginal and Treaty rights. Curt and Mitch will discuss the origins of this duty, when it will apply, and what it requires governments to do. They will focus on Saskatchewan's response to this duty as reflected in Consultations Guidelines which were adopted in May 2006. They will also discuss some of the practical implications that the duty will have for the mining industry.

[1] Constitutional Law Branch, Saskatchewan Justice, 820 - 1874 Scarth Street, Regina, SK S4P 4B3.

Athabasca Regional Perspective on Exploration

Vice-Chief D. Deranger [1]

Abstract

Vice-Chief Don Deranger will deliver a presentation from the perspective of Athabasca communities and residents, in particular the Athabasca first nations. He will discuss the relationship between existing operating mines and the communities and will give an overview of the successes and areas to build on which can serve as an example to the exploration industry. Vice-Chief Deranger will outline some of the many economic successes in the Athabasca region in an attempt to dispel many of the myths about the Athabasca regions' people and communities. From a first nation point of view, an overview of key areas of importance with respect to exploration will be discussed including the need to respect the land, the local people, and to ensure the local population receives the economic benefits. Finally, Vice-Chief Deranger will highlight some of the successes that have occurred in the exploration industry to date which can serve as examples for the exploration industry as a whole.

[1] Prince Albert Grand Council, P.O. Box 2350, Prince Albert, SK S6V 6Z1.

Technical Session 2:
Rae and Hearne – Geology and Metallogeny

Highlights of Quaternary Investigations of the Charcoal Lake (NTS 64L-9 and -16) and Cochrane River (NTS 64L-10, -11, -14, and -15) Areas

J.S. Smith [1]

Abstract

Quaternary geological investigations were initiated in the Cochrane River–Charcoal Lake area (NTS map sheets 64L-9, -10, -11, -14, -15, and -16) as part of the multidisciplinary, multi-year Wollaston Lake Project. The Quaternary component involves 1:50 000 scale surficial geological mapping, collection of ice-flow indicators, and a regional till sampling program.

Drift cover is extensive and includes till, organics, and glaciofluvial terrains as the main surficial units. Glacial landforms include hummocky stagnant ice-contact drift, thick blankets and plains, streamlined forms, and boulder fields. Large esker systems extend over the entire map area. These features are attributed to a slowly retreating ice margin, at which there was an abundance of meltwater that flowed both in channels and occasionally as turbulent sheet floods.

Multiple ice-flow directions were documented. However, the ice-flow history remains preliminary as age relationships were only identified at five sites. The main regional ice flow was towards the south-southwest (207°). Initial flow ranged between the west-southwest to southwest (258° to 235°), and was followed by a southward (190°) flow before the main flow was established. Rare striae recording a south-southeast flow (163°) and a flow orientated west-northwest–south-southeast (295° to 115°) were also identified.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

Bedrock Geology Along the Northern Margin of the Athabasca Basin West of Fond-du-Lac (NTS 74O-5 and -6), South-central Beaverlodge Domain, Rae Province, Fond-du-Lac Project

K.E. Ashton [1], B. Knox [2], K.M. Bethune [2], and J. Marcotte [2]

Abstract

Mapping along the northern shore of Lake Athabasca, west of Fond-du-Lac, has revealed a western zone dominated by garnetiferous diatexite and foliated to gneissic granite-granodiorite, a central zone dominated by supracrustal rocks, and an Eastern Plutonic Complex mainly comprising tonalitic to dioritic rocks. The supracrustal rocks include quartzite and pyribolite of the ca. *2.3 Ga Murmac Bay Group, and widespread psammopelitic gneiss that may be dominantly Archean in age and probably represent the precursors of the garnetiferous diatexite. Apparently intrusive relationships suggest that the psammopelitic gneiss is older than the foliated to gneissic granite-granodiorite; however, heterogeneous biotite-pyroxene gneisses in the central zone are commonly flanked by Murmac Bay Group quartzite and are thought to represent paleo-weathered equivalents of the foliated to gneissic granite-granodiorite suite.*

Following development of the main regional foliation, the region underwent close to isoclinal, east-southeast–trending F2 folding tentatively attributed to the ca. *1.93 Ga Taltson Orogen. Subsequent open to close, northeast-trending F3 folding is attributed to* ca. *1.90 Ga activity along the Snowbird Tectonic Zone. All three phases of deformation were apparently accompanied by granulite-facies metamorphic conditions. Late northeast-trending lamprophyre and minor granitoid dykes are thought to have been emplaced in response to east-west shortening resulting from the* ca. *1.83 Ga Trans-Hudson Orogen and Slave Indentor.*

Uranium is concentrated in: 1) anatectic granite sheets derived by partial melting of paragneiss during metamorphism; 2) late northeast-trending felsite dykes; and 3) locally hematitic, late brittle faults cutting psammopelitic gneiss or garnetiferous diatexite. The latter probably represent unconformity-type mineralization related to the nearby Athabasca Group.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Department of Geology, University of Regina, 3737 Wascana Parkway, Regina, SK S4S 0A2.

Reconstruction of the Ice-flow Chronology and Glacial Dispersal in the West Fond-du-Lac Project Area, Northeast Lake Athabasca

J.E. Campbell [1], K.E. Ashton [1], and B. Knox [2]

Abstract

Mapping of ice-flow indicators in the Fond-du-Lac area, northeast Lake Athabasca (part of 74O-5 and -6), provides new evidence for a complicated ice movement chronology during the Late Wisconsinan. This work is part of the Quaternary component of the multidisciplinary, multi-year Fond-du-Lac Project initiated this year by the Saskatchewan Geological Survey.

Previous mapping indicates converging ice-flow directions along the northern edge of the Athabasca Basin. South of the Fond du Lac River and southeast of Lake Athabasca, the regional ice flow is almost due west. North of Lake Athabasca, the main regional flow is to the southwest. These different regional ice-flow directions converge in the study area.

Erosional ice-flow indicators with cross-cutting relationships have been spectacularly preserved on the glacially-sculpted, polished and striated outcrops of Lake Athabasca's north shore. This year, lower lake levels exposed fresh, new outcrop surfaces, often with preserved striae related to older ice flows.

The multiple ice-flow directions indicate complex spatial and temporal variations in ice flow. Four main phases of flow are tentatively identified. Indicators recording intermediate stages of the shifting ice flows over time and local variations due to topographic controls are common. The oldest flow was to the west (Phase I), followed by a shift to the southeast-south (Phase II). By the onset of deglaciation, ice flow had swung to the southwest (Phase III), the main ice-flow direction recorded. During the last stages of deglaciation, ice again flowed to the west (Phase IV). Rare, faintly preserved striae sets trending northwest-southeast were also recorded, however, the direction of flow is unknown. On a regional-scale, the "Athabasca Low" played a significant role in channelling early and late stage ice flows.

Exotic clasts provide valuable information concerning glacial dispersal, erosion, and transport. Sandstone detritus is found in till, on beaches and as perched boulders on outcrops north of Lake Athabasca. If these erratics are Athabasca Sandstone, then the Athabasca Basin must have extended north-northeast of the present shoreline for more than several kilometres prior to glaciation. The occasional red porphyritic rhyolite clasts are derived from Pitz Formation, Wharton Group rocks in the Baker Lake area, Nunavut, over 500 km to the northeast.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Department of Geology, University of Regina, 3737 Wascana Parkway, Regina, SK S4S 0A2.

New Multisensor (Gamma-ray Spectrometric and Magnetic) Airborne Geophysical Surveys – Cree Lake Area, 2006 – Status Report

K.L. Ford [1], J.M. Carson [1], M. Coyle [1], J. Buckle [1], G. Delaney [2], and R.B.K. Shives [1]

Abstract

Ongoing collaboration between Saskatchewan Industry and Resources (SIR) and the Geological Survey of Canada (GSC) through its Northern Resources Development Program, is generating new multisensor (gamma-ray spectrometric and magnetic) geophysical data for areas of mineral potential in the Precambrian Shield of northern Saskatchewan. The resulting new surveys support a new geoscience infrastructure including improved framework geological mapping and better mineral exploration strategies.

On July 25, 2006, Sander Geophysics Limited of Ottawa commenced with a high-resolution fixed-wing airborne gamma-ray spectrometric and total field magnetic survey over the Cree Lake area (Figure 1). The survey area covers portions of the Lloyd, Virgin River, and Mudjatik domains and the southern edge of the Athabasca Basin. Parts of NTS map sheets 74G and 74F were surveyed. Funding for the airborne geophysical survey was provided through the Government of Saskatchewan's Mineral Exploration Incentive Program. The survey was designed cooperatively by SIR and GSC. The GSC's Radiation Geophysics and Regional Geophysics Sections in Ottawa, under the Northern Resources Development Program, provided contract supervision and quality control to national NATGAM standards.

The new survey comprises 13 319 line kilometres along west-northwest–east-southeast–oriented flight lines spaced 400 m apart and north-northeast–south-southwest–oriented magnetic control lines spaced 3000 m apart. Sensors included a large-volume gamma-ray spectrometric detector (NaI, 50 l downward and 8 l upward looking) sampling every one second, and a caesium vapour magnetometer sampling 10 times per second. Data acquisition was completed on September 5, 2006. This new data provides improved geophysical and geochemical information that will enhance understanding of tectonic and metallogenic aspects of part of the southern Rae Province south of the Athabasca Basin.

Survey results will be published as joint SIR and GSC Open Files in late spring or early summer, 2007. Data will be available in a number of formats including plot-on-demand colour interval maps at 1:50 000 and 1:250 000 scale. PDF files for each of the map products and digital data are both available on CD-ROM or as free download from the GSC's Geoscience Data Repository at http://gdr.nrcan.gc.ca/index_e.php.

[1] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.
[2] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

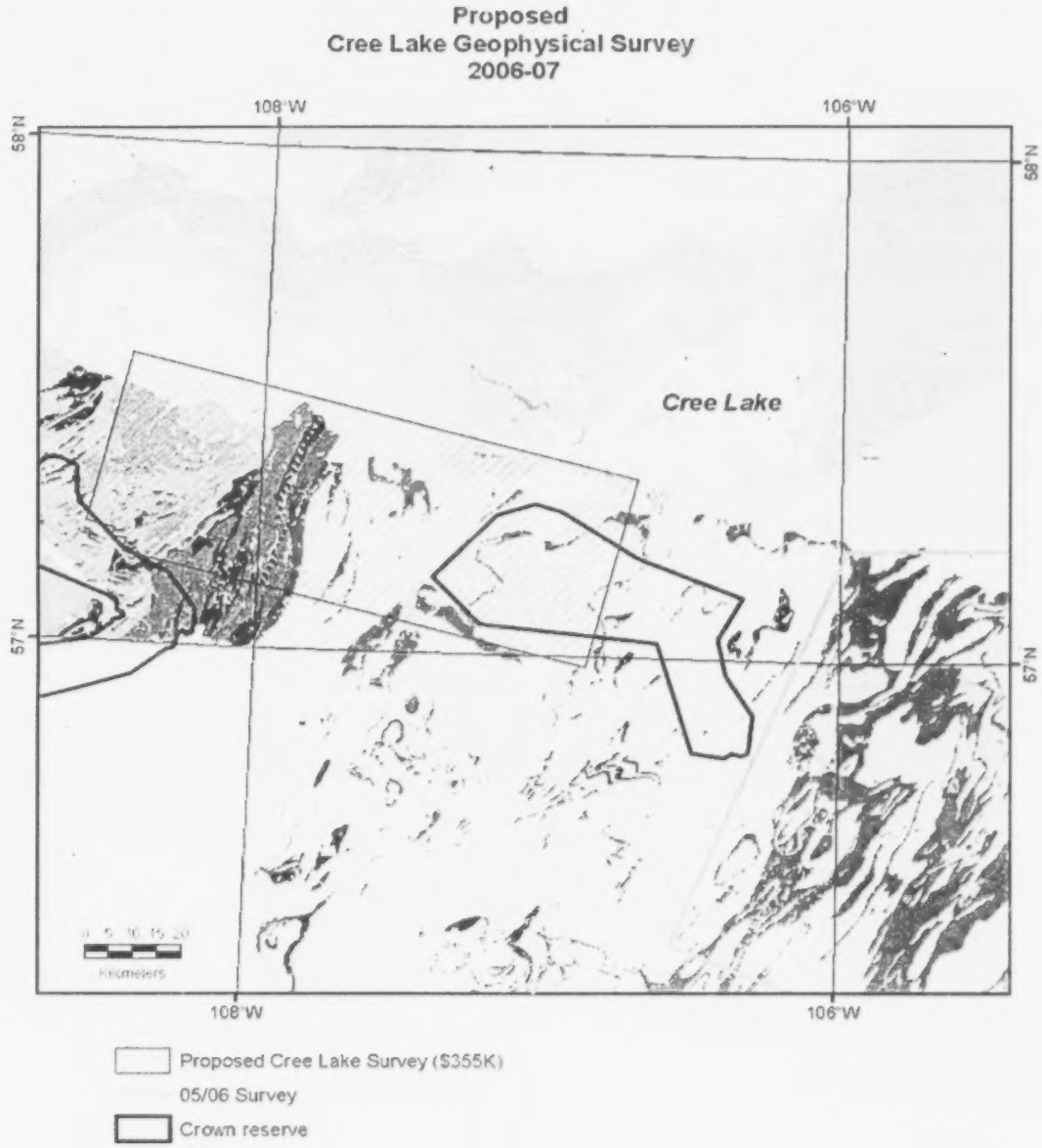

Figure 1 - Location of the 2006 high-resolution fixed-wing airborne gamma-ray spectrometric and total field magnetic survey over the Cree Lake area.

Platinum-group Element Mineralization in the Peter Lake Domain: A Saskatchewan Analogue to Lac des Iles?

R. Maxeiner [1], N. Rayner [2], J.E. Campbell [1], D. Corrigan [3], and L. Hulbert [2]

Abstract

The Peter Lake Domain, a southeastern component of the Hearne Province in northern Saskatchewan, includes several granitic and gabbroic complexes that range in age from 2.70 to 1.83 Ga. Supracrustal rocks make up only a very small percentage of the domain and include Neoarchean migmatitic sedimentary and volcanic rocks, and Paleoproterozoic argillaceous successions of the Campbell River Group. The domain has been variably affected by at least two metamorphic events, a high-grade Neoarchean event and a low-grade Paleoproterozoic event.

Brecciated and 'varitextured' gabbros of the Peter Lake Domain show many similarities in lithology, texture, and style of mineralization to the gabbros hosting the Lac des Iles and Marathon platinum-group element (PGE) deposits, recently reclassified as magmatic breccia-type PGE-(Ni-Cu) deposits. Generally, they are characterized by less than 5%, but typically only around 1 to 2%, disseminated chalcopyrite and pyrrhotite within stock-like or layered, generally large mafic-ultramafic intrusions. Both at Lac des Iles and at the Marathon deposit, mineralizatton is closely associated with brecciated and 'varitextured' gabbros. 'Varitextured' gabbros are those having variable grain size, ranging from fine to very coarse, and locally pegmatitic. Cumulate textures and rhythmic layering are also present at both localities.

In the Peter Lake Domain, several PGE occurrences are hosted by the oldest and most extensive suite of gabbroic rocks, the 2.56 Ga Swan River Complex, which was intruded into granites and granitoid gneisses of the Hearne Craton. At least one of the PGE-occurrences (Antoine) is in gabbros of the much younger 1.92 Ga Porter Bay Complex. Some of the most significant PGE-bearing sulphide showings are Antoine (~3.1 ppm Pt-Pd, 0.96% Cu in a grab sample), Peter Lake East, Swan Lake, and 'Haglund East Lake'. Host rocks include gabbro, leucogabbro, and minor gabbronorite and monzodiorite. All of the known PGE occurrences in the Peter Lake Domain are also in or near areas of varitextured, pegmatitic and/or brecciated gabbros, suggesting that gabbros having these textures are key exploration targets.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.
[3] Geological Survey of Canada, Natural Resources Canada, 615 Booth Street, Ottawa, ON K1A 0E9.

Technical Session 3:
The Trans-Hudson Orogen – Geology and Metallogeny

Geochronology Update: A New Age From the Upper Hurwitz Group at Many Islands Lake and Preliminary Results from the Northeast Wollaston Domain Project

C.T. Harper [1], B. Davis [2], C. Card [1], and N. Rayner [2]

Abstract

New U-Pb zircon ages were obtained from a feldspar phyric rhyolite from Hurwitz Group rocks at Many Islands Lake in northeastern Saskatchewan and from granite and monzodiorite of the Wollaston Domain in northern Wollaston Lake. The sampled rhyolite is a rare rock type in the Hurwitz Group. It is associated with cherty quartzite, calcareous chert breccia, and felsic tuff breccia, which together overlie a thick pelitic succession and underlie a thinner pelite which is overlain by marble and calc-silicate rocks correlated with the Watterson Formation of the upper Hurwitz Group. Zircons from the rhyolite display morphological complexity and are considered to be primarily detrital with a slight possibility of some being primary volcanic zircons. The zircons are believed to have been mainly picked up by the magma as it passed through the underlying pelitic succession. U-Pb zircon SHRIMP ages range from 2.71 to 1.97 Ga with four prominent modes recognized; ca. *2.7, 2.6, 2.07, and 1.99 Ga. The two Archean modes are typical of the local basement rocks and could have been derived directly from the basement as the magma passed through, but more likely were detrital grains derived from the underlying pelitic rocks. The 2.07 Ga age mode is similar in age to volcanic rocks associated with rifting of the southeastern Hearne margin and initiation of deposition of the Wollaston Supergroup at* ca. *2.075 Ga. Although uplift and erosion of the Wollaston rift succession seems unlikely, it remains a possibility and perhaps there are, as yet unrecognized, rocks of that age that are more proximal to the Many Islands Lake area. The* ca. *1.99 Ga zircons are either: detrital/xenocrystic, in which case the 1.97 ±0.05 Ga youngest zircon represents a maximum age for deposition; or igneous in which case the weighted mean age of 1.99 ±0.01 Ga represents the time of crystallization and deposition of the cherty sedimentary units. These latter ages are in close agreement with the maximum depositional age of 1.96 Ga obtained for the Watterson Formation, the lowermost unit of the upper Hurwitz Group in Nunavut. Therefore, the cherty quartzite–rhyolite unit can be correlated with the upper Hurwitz. The underlying pelitic sequence, however, could be: 1) very similar in age to the felsic volcanic and, therefore, could be correlated with upper Hurwitz; 2) significantly older than upper Hurwitz Group, but younger than the Ameto Formation of the lower Hurwitz Group; or 3) correlated with the Ameto Formation and be approximately 150 million years older than the rhyolite.*

New U-Pb zircon age dates were obtained from igneous rocks along the northern part of Wollaston Lake. A garnetiferous felsic rock spatially associated with quartzite-psammite-amphibolite rocks previously correlated with the Hidden Bay Assemblage, but recently interpreted to be part of the Lower Sequence of the Wollaston Supergroup, yielded a preliminary U-Pb SHRIMP crystallization age of 2565 ±11 Ma indicating that the felsic rock represents a basement inlier. Garnet in this rock together with its relationship to the presumed basal Wollaston Supergroup suggests it may represent the metamorphosed equivalent of a zone of pre-Wollaston Supergroup lateritic weathering. This age is consistent with other granitic basement rocks of the eastern Wollaston Domain and Peter Lake Domain. In addition, this rock contains two Paleoproterozoic zircon populations of 1812 ±7 Ma and 1776 ±7 Ma which correspond to periods of pegmatite generation and metamorphism in the Trans-Hudson Orogeny. A weakly deformed monzodiorite that intruded deformed and metamorphosed Wollaston Supergroup rocks at Kiteley Bay, Klemmer Lake yielded a U-Pb TIMS crystallization age of 1829 ±1 Ma. This age represents a minimum age for early deformation event(s) and related high-grade metamorphism that were apparently responsible for producing the dominant northeast structural trend of the Wollaston Domain, and predates the generally accepted peak metamorphic age of ca. *1.82 to 1.81 Ga.*

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.

TGI-3 Flin Flon Project: A New Initiative to Support Base Metal Reliant Communities

S. Pehrsson [1]

Abstract

The Targeted Geoscience Initiative-3 Flin Flon project is a five-year, integrated multidisciplinary geoscience project to help in the discovery of new reserves of base metals in vulnerable established mining communities of the Paleoproterozoic Trans-Hudson Orogen in Saskatchewan and Manitoba. Its central objective is to contribute directly to improving the geoscience knowledge of targeted established mining districts, thereby reducing the risk inherent in exploration and development associated with the deepening of existing mining operations and the search for new hidden deposits. In addition, it will contribute to filling the capacity gap in highly qualified personnel in the base metal exploration sector.

The project, developed and delivered through a tripartite provincial-federal-industry partnership and in its second year of operation, will be focussed on the world-class Paleoproterozoic base metal mining camps of Saskatchewan and Manitoba, stretching from the presently producing Flin Flon–Creighton camp to the recently closed, but highly promising Lynn Lake camp.

The Flin Flon TGI-3 project will comprise three major subcomponents. The Tier One (highest priority, lowest risk) subcomponent will focus on base-metal rich portions of the Glennie–Flin Flon–Snow Lake district, and will include geoscience directly related to the extending existing reserves of base metals and elucidating new occurrences in the district; specifically:

1) *a 1:10 000 bedrock map of the Flin Flon–Mandy VMS camp and supporting geoscience studies including stratigraphy, volcanic architecture and structure in the Glennie–Flin Flon–Snow Lake–Sherridon district;*
2) *a camp-scale Flin Flon 3-D knowledge cube underpinned by a 2-D seismic study and subsurface geochemical, stratigraphic and structure data;*
3) *airborne surveys of part the northern Hanson Lake block and southern Glennie Domain, Saskatchewan and remote predictive interpretation maps based on integration of the airborne surveys with targeted new mapping; and*
4) *supporting ore mineralogy, sulphide geochemistry, and isotopic studies.*

The Tier Two (second priority, moderate risk) subcomponent will focus on regional Trans-Hudson base metal potential and includes:

1) *magmatic Ni-PGE–potential and lithogeochemistry-isotopic studies of mafic intrusions the northern and western Lynn Lake and La Ronge greenstone belts;*
2) *a synthesis of the surficial geology of Saskatchewan and Manitoba, including supporting till geochemical analyses, airphoto interpretation, and targeted surficial mapping;*
3) *an airborne survey in the Wuskwatim Lake area, west of Thompson, Manitoba, associated targeted field mapping and supporting isotopic and geochemical analyses, resulting in new 1:100 000 maps of the eastern Kisseynew belt; and*
4) *an airborne survey in the Partridge Breast area, north of Leaf Rapids, Manitoba and updated bedrock geological maps of the Lynn Lake–Partridge Breast area.*

The Tier Three (third priority, highest risk) subcomponent will focus on identifying and proofing targets for iron-oxide–copper–gold potential in the region through targeted field and supporting lithogeochemical and isotopic studies.

[1] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8

Evidence for Cauldron Subsidence at the Flin Flon Mining Camp, Saskatchewan and Manitoba: Implications for the Location of Volcanogenic Massive Sulphide Deposits

H. Gibson [1], K. Bailey [1], M. DeWolfe [1], K. Gilmore [2], C. Devine [2], D. Sims [2], A. Bailes [3], and K. MacLachlan [4]

Abstract

The Paleoproterozoic Flin Flon camp of the Trans-Hudson Orogen, is host to the world-class Flin Flon–Callinan–777 volcanogenic massive sulphide (VMS) ore system that contains some 85.5 M tonnes grading 2.2% Cu, 4.3% Zn, 2.49 g/t Au, and 38.16 g/t Ag. Previous work and ongoing detailed mapping indicates that volcanic strata on the west limb of the Hidden Lake syncline, which host the known VMS deposits, occur within a synvolcanic subsidence structure, or cauldron as defined by: 1) a thick but aerially restricted package of predominately mafic megabreccia deposits containing blocks up to 50 m in size; 2) internal angular unconformities; 3) basaltic dyke swarms localized within the presumed core of the cauldron; and 4) and numerous synvolcanic faults. Recent mapping of the Beaver Road anticline located west of the Flin Flon Lake fault has partially defined the western (southern?) structural margin of the cauldron. Here an abrupt lateral change from coherent flows that are interpreted to lie outside of the cauldron to intracauldron volcaniclastic rocks is defined by prominent synvolcanic faults, mafic megabreccias, basaltic and rhyolitic dyke swarms, basaltic vents, and intense epidote-quartz alteration. Subsidence along this margin occurred throughout eruption and emplacement of the entire Flin Flon formation. The absence of Millrock member rhyolitic flows, domes, and associated volcaniclastic rocks that are spatially and temporally associated with the Flin Flon, Callinan, and 777 VMS deposits has hampered recognition of the VMS favourable Millrock member along this margin. The younger, largely intrusive Myo Rhyolite may have been emplaced into Millrock equivalent strata, or the favourable "Millrock interval" may, along this cauldron margin, be represented by proximal basalt flows, tuffs, and megabreccias?

[1] Mineral Exploration Research Centre, Department of Earth Science, Laurentian University, 935 Ramsey Lake Road, Sudbury, ON P3E 2C6.
[2] Hudson Bay Exploration and Development Company Limited, Box 1500, Flin Flon, MB R8A 1N9.
[3] Manitoba Geological Survey, Manitoba Science, Technology, Energy and Mines, 1395 Ellice Avenue, Winnipeg, MB R3G 3P2.
[4] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

Stratigraphy, Structure, and Silicification: New Results From Mapping in the Flin Flon Mining Camp, Creighton, Saskatchewan

K. MacLachlan [1]

Abstract

Two areas in the Flin Flon mining camp were mapped at a scale of 1:5000, one area between Douglas Lake and West Arm Road on the west limb of the Beaver Road Anticline, and the other on the peninsula between Green Lake and Phantom Lake. In the Douglas Lake area, mapping was undertaken in the hanging wall of the west-younging, felsic-dominated Myo member of the Flin Flon formation. Significant findings include an extrusive felsic unit above the upper contact of the Myo member, abundant peperite at several stratigraphic levels, an up to 100 m wide zone of semi-conformable silicification, and pervasive sinistral shearing that post-dates the Phantom Intrusive Suite.

In the Green Lake Peninsula area, three fault-bounded successions with opposing younging directions were recognized. The easternmost succession, east of the newly defined Burley Lake Fault (a modified version of the Phantom Lake Fault), is part of the west-younging Louis formation on the east limb of the Burley Lake Syncline. The east-younging succession between the Burley Lake and Green Lake faults comprises a large component of fine-grained mafic volcaniclastic rocks intercalated with aphyric and plagioclase ± pyroxene porphyritic flows, and is tentatively correlated with the Hidden formation. The west-younging succession west of the Green Lake Fault is tentatively correlated with the west limb of the Beaver Road Anticline. The Green Lake Fault is a fairly late structure that overprinted a multiply reactivated fault zone that runs down the centre of the peninsula and may be a continuation of the Flin Flon Lake Fault. The boundary between the east- and west-facing successions occurs within this complex fault zone and the timing and nature of the original boundary in not known.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

New Till Geochemistry Results from the Targeted Geoscience Initiative 3: Implications for Regional Base Metal Exploration in the Glennie and Kisseynew Domains

I. McMartin [1] and J.E. Campbell [2]

Abstract

The TGI-3 Flin Flon project, a collaboration between the Geological Survey of Canada, the Saskatchewan Geological Survey, the Manitoba Geological Survey, and industry partners, was designed to aid in the discovery of new reserves of base metals in the established mining communities of the Trans-Hudson Orogen in Saskatchewan and Manitoba. Supracrustal rocks of the Paleoproterozoic Trans-Hudson Orogen, highly prospective for base metal mineralization, are frequently covered by Quaternary sediments. Drift prospecting, therefore, represents an essential tool for mineral exploration in this discontinuously exposed region of the Canadian Shield. By providing a trans-jurisdiction compilation and synthesis of till composition, a regional ice-flow interpretation, and a surficial geology compilation at 1:500 000 scale, the Quaternary component of this project will contribute directly to improving the geoscience knowledge of targeted established mining districts. In addition, it will help promote base metal exploration in the region outside the historic Flin Flon mining camp. The objective is to outline regions with potential mineralization, identify areas for more detailed drift sampling, and provide the geologic framework for implementation of successful detailed drift prospecting programs.

In the initial phase of this sub-project, geochemical analyses were recently completed on archived till samples collected by the Saskatchewan Research Council (SRC) in the Glennie and Kisseynew domains, Saskatchewan (1974-1977). These till samples, most collected from C-horizon soils, had never been previously analyzed. This talk and concurrent web-release provide the geochemical results on 366 archived till samples collected from 343 sites (about one site per 100 km^2). The silt and clay fraction (<0.063 mm) was analysed at SRC for a suite of trace elements using ICP-AES after a partial digestion (HNO_3-HCl, 8:1); major and trace elements were also analysed using ICP-AES after a near total digestion ($HF/HNO_3/HClO_4$). Gold concentrations were determined by Fire Assay/ICP-MS. Selected samples were analysed for texture using a combination of wet sieving and Pipette methods. A brief discussion on till provenance and implications for regional base metal exploration will be presented.

[1] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.
[2] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

The Deschambault High-resolution Aeromagnetic Survey: Towards a New Interpretative Geological Map

D. Corrigan [1], M. Pilkington [1], and F. Kiss [1]

Abstract

A new high-resolution aeromagnetic survey (Deschambault Lake survey) was flown over the southern extents of the Glennie Domain of the Trans-Hudson Orogen, Saskatchewan, as part of the Flin Flon Targeted Geoscience Initiative 3 (TGI-3) project. A total of 18 074 line kilometres were flown with traverse line spacing of 400 m, at a nominal terrain clearance of 150 m. The survey data were released simultaneously by the Geological Survey of Canada and Saskatchewan Geological Survey (SGS) on July 7, 2006 in the form of 24 1:50 000 scale maps consisting of residual total magnetic field (12) and the first vertical derivative of the magnetic field (12). Precambrian rocks in the survey area, located southwest of Flin Flon and approximately 50 km north of the northernmost known Fort à la Corne kimberlite pipe, are in large part blanketed by Phanerozoic sedimentary rocks as well as locally abundant glacial cover. The high-resolution data offer a much-improved spatial resolution of rock units with distinct magnetic properties and hence permit better-constrained interpretations of the sub-Phanerozoic basement geology along the southern extents of Glennie Domain, as well as parts of the mostly buried Wapawekka and Tobin domains. In order to provide additional constraints on the interpretation of the new aeromagnetic data, the project was augmented by targeted fieldwork and examination of available drill core. U-Pb age-dating and tracer isotope study of selected drill core and field samples (in progress) will assist in correlating units within and outside of the survey area.

Preliminary interpretations of the Precambrian geological framework are as follow:

1) *As previously assumed on the basis of few available radioisotopic dates, the Archean to earliest Paleoproterozoic Sask Craton ("Tobin Domain" on SGS interpretative basement maps), appears as a broad region of diffuse magnetic highs along the southwestern corner of the survey area.*

2) *The Sask Craton is structurally and/or stratigraphically overlain by rocks of the Wapawekka Domain, which includes from bottom to top of:*
   i) a low-magnetic 'moat' surrounding the Sask Craton consisting mainly of metapelitic rocks with local sulphide-rich horizons, calc-silicate gneiss, as well as minor oxide-facies iron-formation, all intruded by mafic to ultramafic sills and-or transposed dykes;
   ii) mafic to intermediate volcanic, proximal volcaniclastic rocks and ultramafic rocks of the Wapawekka Narrows Formation;
   iii) mixed volcaniclastic and clastic metasedimentary rocks of the Churchman Island Formation; and
   iv) meta-arkose and conglomerate of the Wapawekka Lake Formation, intruded by a regionally pervasive amphibolite sill.
   Rocks of the Wapawekka Narrows and Churchman Island formations are intruded by granite-granodiorite and tonalite-diorite-gabbro-norite plutonic complexes that have clear aeromagnetic expressions traceable beneath Phanerozoic cover.

3) *A broad zone of diffuse northeast-trending aeromagnetic highs protruding from the Sask Craton suggest that the latter might occur at or near the Proterozoic rock surface, beneath Proterozoic cover, along regional F_2 antiformal culminations.*

4) *Small circular magnetic highs yielding high Keating correlation coefficients occur within the survey area. One such feature examined in the field corresponded to a small ultramafic plug or boudin.*

[1] Geological Survey of Canada, Natural Resources Canada, 615 Booth Street, Ottawa, ON K1A 0E9.

Update on Exploration and Development in the Seabee Mine Area

C. Yuhasz [1], J. Stoeterau [1], and P. Dong [1]

Abstract

Claude Resources Inc.'s northern Saskatchewan Seabee Mine holds the title for the most gold ever mined from a Saskatchewan mine. Between December 1991 and the end of September 2006, approximately 3 133 000 t of ore at an average grade of 7.95 g/t have been processed by the Seabee Plant to recover 742,500 ounces of gold.

The Seabee Mine is a Paleoproterozoic shear zone hosted vein-type gold deposit. Gold, along with other iron sulphides, occurs in a series of narrow, steeply dipping, east-northeast striking quartz veins within shear zones cutting through the metagabbroic rocks of the Laonil Lake Intrusive Complex, Glennie Lake Domain.

These shear zones exhibit indications of a predominantly pure shear regime, which may have minor effects of a simple shear regime towards the end of the system. Original lineation within these shear systems steeply plunges to the northwest, however it is formulated that the actual ore zones within the Seabee deposit are controlled by an intersection of two shearing events. The first orientation identified contains evidence of pure shearing with subvertical lineations; the second proposed "later" orientation displays evidence of simple shear with subhorizontal lineations. It is this possible intersection that may have caused a zone of dilation resulting in high grade ore chutes which plunge steeply to the southeast.

Claude has increased efforts over the last four years to explore the land package around the minesite for mill feed. This has led to the definition of a prospective horizon in the Porky Lake area, located approximately 3 km northwest of Claude's Seabee gold mine in northern Saskatchewan.

The Porky Lake West and Porky Lake East ("Pigeon Lake") gold zones lie on opposite flanks of the large Porky Lake anticline, along a gold-bearing horizon which has been traced intermittently over 7.5 km from the western extent of Porky West zone to the north of the Pigeon Lake zone in the east.

Drill testing from 2002 to 2005 successfully discovered two structural zones of significant mineralization, Main and Porky West. Approval to bulk sample the Porky West zone was received in June 2005 and the removal of ore to facilitate a 5000 t bulk sample was accomplished during the third quarter of this year.

Claude has also outlined two favourable zones in the Santoy Lake area, approximately 12 km east of the mine – Zones 7 and 8. Application to bulk sample Zone 7 was granted and the decline has been driven down to the mineralized lens. The bulk sample is expected to be removed by the first quarter of 2007. Surface drill programs are being carried out to further delineate the mineralized zones.

Other areas of the property are also being studied including the Don's Lake area, lying at kilometre 8 of the all-weather road from the minesite to Santoy. Here a 1300 m long horizon has been defined by mapping and prospecting.

[1] Claude Resources Inc., 200 - 224 4th Avenue South, Saskatoon, SK S7K 5M5.

Golden Band Resources: On the Path to Production

R. Orr [1], R. Avery [1], and A. Partsch [1]

Abstract

Golden Band Resources is a Saskatchewan-based company whose major focus is the long-term, systematic exploration and development of its La Ronge Gold Belt properties. Since 1994, Golden Band has assembled through staking and strategic acquisition a land package of more than 70 000 ha, including nine known gold deposits, four former producing mines, and a licensed gold mill. Now under Golden Band's single ownership, the potential of most of the La Ronge Gold Belt can be assessed as a whole, gaining economies of scale by linking the deposits with a centrally located mill. This strategy is continuing, with the recent acquisition of an interest in the Greywacke deposit. With a gold portfolio worthy of an intermediate mining company, Golden Band is moving along the path of transforming itself from a junior exploration company into an emerging gold producer.

Exploration highlights during 2006 include the discovery of the Birch Crossing gold deposit, the definition of the EP deposit, the discovery of two new gold prospects by the drill testing of bulk till anomalies, trenching, prospecting and geological mapping, and test surveys for a new geochemical method – soil gas hydrocarbon geochemistry.

Exploration plans in 2007 will focus on continued drill-testing of several deposits and gold prospects, and in the further definition of higher-grade gold mineralization that may provide mill feed for Golden Band's Jolu Mill.

Currently, the company's pre-development work continues, with substantial preparatory work either having been completed or in progress in 2006. The key piece in setting the future direction of development will be the outcome of a re-focussed scoping study examining a higher-grade, lower-tonnage scenario using the existing Jolu Mill, with production coming from the Bingo deposit as well as from portions of other higher-grade deposits owned by Golden Band. A minimum five-year project life is being considered. The revised scoping study is expected to be completed in the first quarter of 2007.

Golden Band's mid-term (five-year) goal, based on a positive scoping study, is a staged development program using the centrally-located Jolu Mill, with a five-year year project life at a daily milling capacity of 450 to 500 t, producing some 35,000 ounces per year. The company's vision beyond this initial production, based on a successful start-up, includes a longer-term goal of maintaining gold production for 10 years in the La Ronge Gold belt from a central milling facility at 1500 t/day, producing some 115,000 ounces per year.

Golden Band's technical leader, Klaus Lehnert-Thiel recently resigned for health reasons from his position of Exploration Vice President, a position he had held since 1993. While his day-to-day leadership is missed, his guidance will continue to play a role in our work. All of us at Golden Band would like to take this opportunity to publicly acknowledge and to thank Klaus for his years of dedication and hard work that has served us so well to put us on this "Path to Production".

[1] Golden Band Resources Inc., 108 - 701 Cynthia Street, Saskatoon, SK S7L 6B7.

Some Mineral Exploration Ideas for Phanerozoic, Sub-Phanerozoic, and Less-explored Precambrian Areas in Saskatchewan

M. Rogers [1]

Abstract

Some ideas for mineral exploration, developed by the staff of the Northern Geological Survey Branch, are presented for some less explored and remote areas in central and northern Saskatchewan. A presentation of these ideas during the current boom in commodity prices and exploration may encourage a further examination of some of these areas.

Ten separate prospective areas are presented which could represent eight different mineral deposit types. These include:

1) *a potential area for Mississippi Valley-type lead-zinc in the far northwest of the Phanerozoic section;*
2) *kimberlite-hosted diamond potential in the Meadow Lake region;*
3) *two prospective volcanic-associated massive sulphide target areas in the Sub-Phanerozoic basement;*
4) *potential structurally-controlled rare earth elements associated with the Parker Lake Shear Zone;*
5) *a prospective area for structurally-controlled lode gold associated with the Ennadai Group in the Phelps Lake map sheet;*
6) *potential granite-pegmatite hosted rare metals in the southern Phelps Lake map sheet;*
7) *mafic-ultramafic intrusion-hosted magmatic nickel-copper-cobalt potential associated with the Chipman Diabase Sills in the Tantato Domain; and*
8) *granite-pegmatite–hosted rare earth element potential in localities in the Mudjatik and Lloyd domains.*

Almost all of these areas are currently open and available for staking.

*The annual update on the **regional land-use plans and the Representative Areas Network (RAN) program** will not be given this year. These programs are still quite active. For more information please contact me or visit my poster. Detailed handouts are also available at the poster.*

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

Potash: Past, Present, and Future

A. Mulhall [1]

Abstract

The presentation, "Potash: Past, Present and Future", provides an overview of the global potash industry, keying on Saskatchewan's potash mines. The early history of the world's potash use is explained and its development is reviewed, concluding with a focus in Saskatchewan. The present markets for potash are analyzed. The drivers for market expansion are examined and growth of potash in harmony with the environment is projected into the future.

[1] PotashCorp, Suite 500, 122 - 1st Avenue South, Saskatoon, SK S7K 7G3.

A Concept: A Mineral Research Centre in Saskatchewan

S. Franklin [1] and L. Schramm [2]

Abstract

Saskatchewan's mining and minerals industry has experienced strong growth in the past several decades. The province is now the world's largest producer of potash and uranium, and exciting opportunities are being pursued in diamonds, coal, gold, base metals, rare earths, and specialty clays.

Exploration activity has reached an all-time high, while regulations have become more demanding and responsible environmental stewardship has become paramount. Clearly, future opportunities in the mining and minerals industry will depend on developing knowledge and technologies to serve the entire cycle, from exploration to development, from extraction to remediation.

The proposed Mineral Research Centre (MRC) will provide the leading-edge research to support this vital Saskatchewan industry. Located in Saskatoon, the MRC will be a collaborative effort among industry, academic, and government research institutions. Funded by the federal and provincial governments as well as industry, it will draw primarily upon the research strengths at the University of Saskatchewan and the Saskatchewan Research Council.

As a needs-driven initiative, the MRC will focus on research with direct benefit to industry priorities. In conducting this work, it will also become a source of valuable training opportunities for highly qualified people leading to rewarding careers in Saskatchewan and Canada.

The MRC will be one of only a few mineral research and development centres in the country able to offer basic and applied research and development, demonstration, and final deployment in the field. As a Saskatchewan-based initiative, it will focus on the specific challenges presented by this province's unique resource cluster.

[1] Research Administration, Department of Geography, University of Saskatchewan, 9 Campus Drive, Saskatoon, SK S7N 5A5.
[2] Saskatchewan Research Council, 15 Innovation Boulevard, Saskatoon, SK S7N 2X8.

Technical Session 4:
Saskatchewan Diamonds, Clay, and Oil

Hydrocarbon Potential of the Bakken and Torquay Formations, Southeastern Saskatchewan

K. Kreis [1], A. Costa [2], and K. Osadetz [3]

Abstract

Upper Devonian to Lower Mississippian Bakken Formation shales in the Williston Basin are rich source rocks that are believed to have generated and expelled at least 16 billion m^3 (100 billion barrels) of light oil (~40° API), but only a small fraction of this Bakken-sourced oil has been identified in, or produced from, Williston Basin reservoirs. Over the past few years, multi-lateral horizontal well completions and large sand-fracture completions in low-permeability reservoirs have resulted in significant new Bakken production in the Williston Basin. Careful examination of cores, geophysical logs, and production data indicates a high potential for further development through horizontal completions in low-permeability by-passed pay that typically shows low resistivity and in undiscovered reservoir sandstones of the Middle Member of the Bakken Formation in southeastern Saskatchewan.

In recent years, dolostones and dolarenites of the Upper Devonian Torquay Formation, underlying the Bakken Formation, have, for the first time, also proven to be productive along their subcrop edge in an area straddling the Saskatchewan-Manitoba border where, large land positions have been taken in pursuit of 40° API oil from the Torquay Formation at depths of less than 1100 m.

[1] Petroleum Geology Branch, Saskatchewan Industry and Resources, 201 Dewdney Avenue East, Regina, SK S4N 4G3.
[2] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 1310 La Ronge Avenue, Box 5000, La Ronge, SK S0J 1L0.
[3] Geological Survey of Canada, Natural Resources Canada, 3303 -33rd Street NW, Calgary, AB T2L 2A7.

An Old Dog Learns New Tricks: The Whitemud Formation as a Potential Source for High-reactivity Meta-kaolin for Cement and Concrete Markets

L. Kelley [1]

Abstract

Intensely-weathered sandstone at the base of the Whitemud Formation, containing up to 60% kaolinite, crops out near the village of Wood Mountain, about 100 km south of Moose Jaw, and in the Frenchman River valley, near the town of Eastend. The kaolinite is considered to have been formed in situ *through weathering, specifically leaching of alkalis from feldspathic components in arkosic sandstone. The weathered product is a massive, grain-supported to matrix-supported, white to light-grey rock composed of 40 to 80% quartz sand and 20 to 60 % clay minerals, principally those of the kaolin group.*

The kaolinized sandstone was investigated by at least four groups between the early 1980s and 2001 as a potential source of kaolin for filling and coating high-grade papers. More than 200 drill holes outlined a potential resource in the Wood Mountain area that has been estimated to be well in excess of 100 million tonnes (pre-NI 43-101), but the brightness of the kaolin was not equal to the industry-standard material currently mined in Georgia.

Whitemud Resources Inc. acquired a core ground position in 2001 and began exploring markets in which the physical and chemical properties of kaolin were primary and brightness was a secondary consideration. Kaolin that has been kiln-heated to between 600°C and 800°C (calcined) is known as meta-kaolin, and has been used as a Portland cement substitute in specialty and high-performance concretes since approximately the mid-1960s. Meta-kaolin replacement of up to 20% of the Portland cement in concrete mixes has been shown to produce concretes that exhibit increased strength at earlier set times; are more durable and less permeable; and are much less susceptible to the alkali-silica reaction or sulphate attack. Numerous third-parties have verified enhanced performance in concrete using meta-kaolin produced from Whitemud's Gollier Creek deposit in the Wood Mountain area.

While the advantages of using meta-kaolin in concrete are known, its use is not widespread because currently available sources result in increased concrete costs. Whitemud intends to offer meta-kaolin to the cement and concrete industries at a price that will enable concrete producers to offer high-performance products at prices competitive with traditional concrete. Meta-kaolin substitution will also allow concrete producers to "stretch" their limited, sometimes rationed, supplies of Portland cement in a North American market that is experiencing a domestic supply deficit of some 20% or 30 million tonnes per year. Whitemud Resources Inc. expects to begin supplying the North American cement and concrete markets with meta-kaolin late in 2007.

[1] Whitemud Resources Inc., Box 30038, Regina, SK S4N 7K9.

Geology, Setting, and Development of the Hoidas Lake Rare Earth Element Deposit

J. Pearson [1]

Abstract

As the industrial world moves from a fossil fuel based economy to the 'Hydrogen Economy', rare earth elements (REE) are becoming increasingly important. North America has no current primary REE production and the Hoidas Lake REE project is poised to fill this gap.

The Hoidas Lake area, 60 km north-northeast of Uranium City, contains a number of structurally controlled, discordant, northeast trending apatite-allanite-pyroxene veins which lie along a 10 km zone within and bounding the Hoidas-Nisikkatch Fault Zone, a subsidiary of the Black Bay Fault. The veins are hosted in upper amphibolite to granulite grade tonalite gneiss, granitic mylonite, and diorite of the Ena Lake Domain. The REE veins which have been identified to date include the Nisikkatch South veins, the Hoidas South veins, and the JAK Zone in the north-central part of Hoidas Lake.

The only vein explored in detail to date, the JAK Zone, has been drill tested with 70 drill holes and has been defined over a strike length of 700 m, to a depth of 150 m, and varies in width from 1 to 12 m. The Resource defined within this vein system totals 1.364 million t (measured, indicated and inferred) grading 2.16% TREO using a 1.5% TREO cut off. It is open in all directions. The JAK Zone vein system consists of multiple veins occupying an anastomosing fault system bounding enclaves of fresh to weakly altered, tonalite gneiss, granitic mylonite, and diorite, which have undergone variable amounts of ductile and brittle deformation. Four vein types have been identified based on mineralogy and texture. These include apatite veins, diopside-allanite veins and combinations thereof, and diatreme breccia veins, commonly zoned. The diatreme breccia veins contain rounded to subrounded, variably altered, sand to cobble sized fragments of host tonalite and granitic mylonite, as well as fragments of vein material including diopside, allanite, scapolite, and apatite in an apatite ± calcite matrix.

The ore mineralogy of the JAK Zone veins is dominantly apatite and allanite with rare monazite, bastnaesite, chevkinite, and sphene. The gangue mineralogy includes diopside, hyalophane, scapolite, calcite, hornblende, quartz with trace amounts of barite, chlorite, and gypsum.

The mineralogy of the Hoidas and Nisikkatch veins suggests that the pluton from which the vein system was derived is an alkaline complex, although no fragments of alkaline rocks have yet been identified in the diatreme breccia. The presence of unstrained veins and diatreme breccia dykes in the JAK Zone suggests that this pluton is younger, and intruded at a higher crustal level, than the emplacement level of the surrounding amphibolite and granulite grade orthogneisses and is proximal to the veins.

[1] Great Western Minerals Group Ltd., 226 Cardinal Crescent, Saskatoon, SK S7L 6H8

The Influence of Depositional Framework and Stratal Architecture on Volcanic Edifice Preservation in Diamondiferous Kimberlites: Examples from the Fort à la Corne Kimberlite Field, Canada

J.-P. Zonneveld [1], B.A. Kjarsgaard [2], S.E. Harvey [3], and D. MacNeil [1]

Abstract

Kimberlites are typically reported from continental, stable cratonic settings, i.e., regions of inherently low accommodation space. Thus, examples of preserved extrusive pyroclastic kimberlite are rare. Kimberlites in the Fort à la Corne kimberlite field (FALC) in central Saskatchewan, Canada are exceptional in their relative completeness including preservation of volumetrically significant tephra cones and extra-crater pyroclastic deposits. Preservation of extra-crater pyroclastic kimberlite at FALC is a function of available accommodation space, which is related to both volcanic style and local tectono-stratigraphic setting.

The FALC kimberlites erupted in both subaerial coastal plain and shallow marine settings on the margin of the Lower Cretaceous (Albian) epeiric Moosebar-Clearwater Seaway. Regional tectono-stratigraphic setting influenced both the eruptive processes that governed the nature of individual kimberlite volcanic events and post-eruptive kimberlite preservation.

Initial kimberlite volcanism in the area occurred coeval with deposition of the Early-Middle Albian Cantuar Formation. Kimberlite body geometry and the presence/thickness of extra-crater pyroclastic kimberlite in the Cantuar Formation is largely a function of fluctuations in fluvial base level and concomitant variation in available accommodation space. Thick, laterally extensive deposits of pyroclastic kimberlite, as well as variably sized tephra cones, first appear in the marginal/shallow marine Middle-Late Albian Pense Formation and are common in the shallow/deep marine Late Albian Joli Fou Formation.

Volcanically induced faulting (including ring-faults and half grabens) resulted in the creation of local accommodation space proximal to individual kimberlite feeder vents. Preservation of pyroclastic kimberlite, including tephra cones, is related in part to increased accommodation space resulting from a regional marine transgression (i.e., expansion of the lower Cretaceous Moosebar-Clearwater Seaway) and encasement of kimberlite deposits in marine shale. Availability and variation of local and regional accommodation space must be addressed to accurately assess the eruptive histories and develop detailed volcanological models of FALC kimberlites.

[1] Geological Survey of Canada, Natural Resources Canada, 3303 - 33rd Street NW, Calgary, AB T2L 2A7
[2] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.
[3] Shore Gold Inc., 300 224 - 4th Avenue South, Saskatoon, SK S7K 5M5.

Geology of the Star Kimberlite, Fort à la Corne Field, Saskatchewan: Pathfinder Knowledge for Orion South

B.A. Kjarsgaard [1] and S.E. Harvey [2]

Abstract

The Star and Orion South kimberlites are located at the southeastern end of the main kimberlite cluster within the Fort à la Corne kimberlite field in central Saskatchewan, Canada. In 2005, Shore Gold commenced a pre-feasibility study on the Star Kimberlite, which included new grid-drilled core holes into the Star Kimberlite (238 total core holes on Star to date) and further underground bulk sampling of the kimberlite via a 250 m deep vertical shaft (over 3 km of underground lateral drifts to date). At Orion South, 53 new grid-drilled core holes have been completed in 2006. The new drill holes complement 50 existing drill cores and together are used to constrain a geological model for Orion South.

The Star kimberlite body consists of five main kimberlite phases, each with distinct macroscopic, geophysical, and geochemical properties. These properties constrain identification of discrete geological units within individual drill cores and allow for the construction of robust 2-D cross sections and a 3-D solids model. The five main kimberlite eruptive phases includes the Cantuar (the oldest, at least three distinct events), the Pense, the Early Joli Fou, the Mid Joli Fou, and the Late Joli Fou (the youngest) kimberlites. All kimberlite phases are deposited within strata of the Cretaceous sedimentary succession within east-central Saskatchewan. Of the five main kimberlite types, the Early Joli Fou comprises >63% of the estimated tonnage. The geology of the Star kimberlite is described in more detail by Harvey et al. *(2006). Available macrodiamond data for the Star kimberlite from bulk sampling and large diameter RC drilling clearly indicates there is a very strong correlation between geology and diamonds, i.e., different kimberlite eruptive phases at Star have different diamond grades.*

The geologically contiguous Orion South kimberlite complex covers in excess of 250 ha and is comprised of the original geophysical targets #133, #140, and #141. At least seven distinct eruptive phases are recognized at Orion South, although there are only two volumetrically dominant phases. Kimberlite eruptive phases include Cantuar equivalent age, Pense equivalent age (at least four distinct events), Joli Fou equivalent age (coarse-grained eruptive phase and fine-grained eruptive phase), and Viking equivalent age (the youngest) kimberlites. The core of Orion South is dominated by a large mass of Pense matrix-supported volcaniclastic kimberlite (PmsVK) with medium to coarse olivine grains. PmsVK is typically overlain by Pense and Joli Fou age kimberlite breccias, and/or Joli Fou coarse olivine pyroclastic kimberlite (JFoPK), however, the central part of the PmsVK is directly overlain by glacial till. JFoPK is the dominant volumetric kimberlite phase at Orion South and thickens both to the south and to the north of the central region dominated by PmsVK. The geology of the 140/141 part of the Orion South kimberlite complex is described in more detail by Kjarsgaard et al. *(2006). Currently, the largest diamond (~10 carats) recovered from the joint venture property was from a PmsVK mini-bulk sample from Orion South.*

Harvey, S.E., Kjarsgaard, B.A., Zonneveld, J.P., Heaman, L.M., and MacNeil, D. (2006). Volcanology and sedimentology of distinct eruptive phases at the Star kimberlite, Fort à la Corne field, Saskatchewan; Kimberlite Emplacement Workshop, Saskatoon, Sept 7-12, 2006, URL <http://www.venuewest.com/8IKC/files/15%20Harvey.pdf>.

Kjarsgaard, B.A., Harvey, S.E., Zonneveld, J.P., Heaman, L.M., White, D., and MacNeil, D. (2006). Volcanic stratigraphy, eruptive sequences and emplacement of the 140/141 kimberlite, Fort à la Corne field, Saskatchewan; Kimberlite Emplacement Workshop, Saskatoon, Sept 7-12, 2006, URL <http://www.venuewest.com/8IKC/files/21%20Kjarsgaard,Harvey.pdf>.

[1] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.
[2] Shore Gold Inc., 300 224 - 4th Avenue South, Saskatoon, SK S7K 5M5.

Geological Review of the Orion North Kimberlite Complex, Fort à la Corne, Saskatchewan

S.E. Harvey [1] and B.A. Kjarsgaard [2]

Abstract

The ~500 ha Orion North Kimberlite Complex is located in the south-central portion of the Cretaceous-aged Fort à la Corne (FALC) kimberlite field in east-central Saskatchewan. Based on recent drilling, internal geology, tonnage potential, and microdiamond results, Orion North is considered high priority kimberlite within FALC. Drilling has revealed that glaciation has removed the Lower Colorado mudstone above the kimberlite at Orion North. As such, the glacial till is in direct contact with prospective, coarse grained kimberlite at Orion North.

The Orion North kimberlite complex consists of four originally defined magnetic anomalies (120, 220, 147, and 148) and is a multi-phase complex which is the result of episodic kimberlite volcanism punctuated by periods of volcanic quiescence, erosion and sedimentary deposition within the Western Canadian Sedimentary Basin. Kimberlite deposition appears to be dominated by shallow- to sub-marine kimberlite pyroclastic flow deposits which are interstratified with continental to marine sediments of the Cretaceous Mannville and Lower Colorado groups. In general, core logging suggests that kimberlites 147, 148, and 220 form a contiguous, large tonnage body within Orion North, while the adjacent kimberlite body 120 appears to be geologically distinct. Identification of individual eruptive phases within the Orion North kimberlite complex has significant bearing on the understanding of diamond distribution and the recognition of higher-potential eruptive phases. Individual eruptive phase recognition is based on a number of properties including olivine and juvenile lapilli size and abundance, amount and nature of matrix material, indicator mineral composition and abundance, whole-rock chemistry, and geophysics. Preliminary results suggest that a significant volume of kimberlite at Orion North erupted after deposition of the basal part of the Joli Fou Formation, i.e., it is early Joli Fou equivalent in age.

Core drilling continues on Orion North while large-diameter drilling has been initiated in order to recover macrodiamonds which will allow grade and diamond value forecasting leading to the definition of an underground bulk sample location expected to commence in late 2007.

[1] Shore Gold Inc., 300 224 - 4th Avenue South, Saskatoon, SK S7K 5M5.
[2] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.

Evaluation of the World's Largest Diamondiferous Kimberlite District by Shore Gold Inc. and Newmont Mining Corporation of Canada Limited

G. Read [1] and C. Williams [2]

Abstract

A series of transactions has enabled Shore Gold Inc. to gain control over the majority of kimberlites that make up the Fort à la Corne Diamond District in central Saskatchewan. Newmont Mining Corporation of Canada Limited has acquired a 40 percent interest in the Fort à la Corne Joint Venture while Shore retains a 60 percent interest and is the Operator of the FALC-JV. Shore has maintained its 100 percent ownership of the Star Diamond Project.

The Star Diamond Project is more than halfway through a pre-feasibility study, which is scheduled to be completed, with the definition of a NI43-101 compliant Mineral Reserve, by the end of 2007. The Star pre-feasibility has three major components: 1) PQ (75 millimetre) core drilling on a 100 metre grid, from surface, to delineate the kimberlite size and shape and map the internal structure for the compilation of a geological model; 2) underground sampling to recover representative bulk samples of all potentially economic kimberlite lithologies (Cantuar, Pense, Early Joli Fou, Mid Joli Fou, and Late Joli Fou) for diamond grade and valuation purposes; and 3) large-diameter (1.2 metre) grid drilling for the recovery of mini-bulk samples to determine diamond grade and value across the kimberlite, away from the shaft. Most of the surface drilling has been completed and limited infilling is still underway. Phase 3 of the underground bulk sampling will be completed by January 2007. Presently diamond results of 8,158 carats recovered from 51 184 dry tonnes have been published. Forty-three large-diameter drill holes of a total of 62 have been completed. The recently published geological model estimates that Star contains 275.8 million tonnes of kimberlite.

The 2006 FALC-JV exploration program has focussed on the Orion Kimberlite Cluster which includes kimberlites 133, 140, 141, 145, 219, 147, 148, 220, and 120 and contains some seven kilometres of contiguous kimberlite. Over 220 PQ core holes have been drilled in the Orion Cluster since late June. In October, two large-diameter drills were mobilized to Orion North to commence a 20 hole program that will provide a total of some 5000 t of mini-bulk sample that can be used for initial macrodiamond grade and value modelling. Based on the results of this work, a decision will be made to sink a shaft for the recovery of an underground bulk sample from Orion North in 2007. It is anticipated that Orion North will move into pre-feasibility in early 2008.

[1] Shore Gold Inc., 300 224 - 4th Avenue South, Saskatoon, SK S7K 5M5.
[2] Newmont Mining Corporation, Malozemoff Technical Facility, 10101 East Dry Creek Road, Englewood, CO 80112.

Abstracts for Other Papers Appearing in the Summary of Investigations 2006, Volume 2 (CD-ROM)

Age and Provenance of the Paleoproterozoic Thluicho Lake Group Based on Detrital Zircon SHRIMP Geochronology: A Record of Tectonic Activity in the Southwest Rae Province, Saskatchewan

K. M. Bethune [1], R.C. Hunter [2], and K.E. Ashton [3]

Abstract

Results of a U-Pb detrital zircon geochronological study of the middle Paleoproterozoic Thluicho Lake Group are reported. The Thluicho Lake Group is a succession of coarse clastic rocks that was deposited in continental alluvial basins in the central Zemlak domain of the southwest Rae Province. Over 100 analyses were performed on detrital zircons from two stratigraphically well controlled samples from the Waterloo-Wellington lakes area, 10 km west of Uranium City – the 'Camel Lake Member' pebbly arkose of the 'Powder Lake Formation' and the 'Falls Member' arkose-argillite of the 'Camsell Portage Formation'. The youngest detrital zircon, 1922 ±6 Ma, recovered from the stratigraphically higher Falls Member, establishes a new maximum depositional age for the group. This result, together with regional geological relationships, suggests that the group is intermediate in age between development of two major tectonic fronts in this part of the Rae Province; an older, ca. *1.93 Ga east-southeast–trending front that formed at the tail end of Thelon-Taltson orogeny, and a younger,* ca. *1.91 to 1.90 Ga northeast-striking front expressed by the Black Bay Fault and associated northeast-striking structures affiliated with the Snowbird Tectonic Zone. The younger age limit for the group may therefore be significantly older than the previously reported minimum age of* ca. *1.82 Ga.*

The distribution of detrital zircon ages defined by the two samples is remarkably similar, with the majority falling within two age ranges: 2750 to 2500 Ma and 2450 to 2250 Ma. The older age range is dominated by ca. *2600 Ma zircons whereas the younger contains two distinct subgroups of* ca. *2420 and* ca. *2320 Ma. The principal sources of the Thluicho Lake Group were therefore local basement rocks of the Nolan, Taltson, Zemlak (Ena), Beaverlodge and possibly Train Lake domains. Abundant 2450 to 2250 Ma zircons indicate that the* ca. *2.4 to 2.3 Ga Arrowsmith orogen was also a major source of the detritus. A few older (>3100 Ma) and younger (<2250 to 1920 Ma) zircons were likely sourced, locally or regionally, within the Rae Province. All told, the bulk of the Thluicho Lake Group detritus came from rocks that can be inferred to have formed the exhumed hinterland of the Taltson mountain belt.*

A notable feature of the Thluicho Lake dataset is the near-complete absence of 1990 to 1960 Ma zircons, an age range typical of subduction-related plutons of the Taltson Magmatic Zone. The Taltson arc did not supply detritus to the Thluicho depositional basins, supporting the inference that such basins were located in the hinterland of the orogen, which was possibly separated from the foreland by a continental divide.

The data reported herein support correlation of the Thluicho Lake and Nonacho groups.

[1] Department of Geology, University of Regina, 3737 Wascana Parkway, Regina, SK S4S 0A2.
[2] Cameco Corporation, 2121 11th Street West, Saskatoon, SK S7M 1J3.
[3] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

Quaternary Investigations West of Fond-du-Lac, Northeast Lake Athabasca (part of NTS 74O-5 and -6), Fond du Lac Project

J.E. Campbell [1], K.E. Ashton [1], and B. Knox [2]

Abstract

Quaternary geological investigations including 1:50,000 scale surficial mapping, recording of ice-flow indicators, and regional till sampling surveys, were initiated in the Fond-du-Lac area, northeast Lake Athabasca (part of 74O-5 and -6), as part of the multidisciplinary, multi-year Fond-du-Lac Project.

Multiple ice-flow directions indicate complex spatial and temporal variations in ice flow. Four main phases of flow are tentatively identified. Indicators related to intermediate stages of ice-flow shifts and local variations due to topographic controls are common. The oldest flow was to the west (Phase I), followed by a shift to the southeast-south (Phase II). By the onset of deglaciation, ice flow had swung to the southwest (Phase III), the main ice flow direction recorded. During the last stages of deglaciation, ice again flowed to the west (Phase IV). Rare, faintly preserved striae sets trending northwest-southeast were also recorded, however, the direction of flow is unknown. On a regional-scale, the "Athabasca Low" played a significant role in channelling early and late stage ice flows.

Drift cover in the area west of Fond-du-Lac is very sparse. The terrain is rugged, dominated by exposed bedrock outcrop ridges with thin (less than 1 m), discontinuous drift cover on the lower slopes and low-lying areas. Following the retreat of the ice, Glacial Lake Athabasca inundated the region to a previously reported maximum lake level of ~305 m above sea level (asl), although new field evidence suggest it was as high as 365 m asl. The dominant surficial deposits are lake sediments (silt, sand, and clay) and till. Boulder lags and winnowed till on the slopes, sand and cobble beaches, terraces and wave-cut notches all indicate reworking of surficial deposits by the waters of Glacial Lake Athabasca. Minor sand and gravel are associated with meltwater channels of both subglacial and proglacial drainage systems and ice-contact deposits. Sandy glaciolacustrine deposits are derived from wave-reworked glacial sediments.

Sandstone detritus was found in till, on beaches, and as perched boulders on outcrops north of Lake Athabasca. If these erratics are Athabasca sandstone, then it suggests the Athabasca Basin extended north of the present shoreline for more than several kilometres.

A large part of the study area is not suitable for drift prospecting as bedrock, lake sediments, and wave-reworked deposits dominate the terrain.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Department of Geology, University of Regina, 3737 Wascana Parkway, Regina, SK S4S 0A2.

Investigation of the Wollaston-Mudjatik Transition, Charcoal Lake and Cochrane River (parts of NTS 64L-9, -10, -11, -14, -15, and -16)

C.D. Card [1], C.T. Harper [1], N. Barsi [2], J. Lesperance [3], and J.S. Smith [1]

Abstract

In 2006, a second mapping transect was completed across the northwest Wollaston Domain and the Wollaston-Mudjatik boundary. As was the case in 2005, two distinct successions were identified in the Paleoproterozoic Wollaston Supergroup. The extreme southeast part of the transect is dominated by an upper succession of arkose, calcareous arkose, and calc-silicate rocks; whereas, to the west, the lower succession contains graphitic pelite, psammopelite to pelite, calcareous psammopelite to pelite, and psammite. The transition between the two lithologic associations is abrupt, suggesting that they are separated by a discontinuity. Basement rocks to the Wollaston Supergroup are spatially associated with the lower succession. The oldest basement rocks are a supracrustal succession, including intermediate to mafic volcanic rocks, ferruginous metasedimentary rocks, and banded iron formation, which was intruded by quartz diorite and granodiorite. Those rocks were intruded by large tonalite plutons, which were, in turn, intruded by granites. Basement rocks core elongate and sometimes overturned domes that are mantled by rocks of the Wollaston Supergroup. Younger Trans-Hudson-age anatectic granites intrude both the Wollaston Supergroup and its basement rocks.

All of the rocks in the region, with the exception of the youngest intrusive rocks contain a well-developed composite S_1 foliation. Early mylonitic foliations are parallel to the S_1 foliation. Regional-scale, northwest-trending F_2 folds can be recognised in a low-strain panel west of Charcoal Lake. Orthogonal, high-amplitude F_3 folds interfered with F_2 to form elongate basins and domes, except in the low-strain panel where the structures are symmetrical. The F_3 folds were overturned and commonly had their limbs sheared off under a dextral transpression stress regime. D_3 structures postdate the peak metamorphic assemblages and all lithologies except for the ca. *1.27 Ga Mackenzie diabase dykes. Northwest-trending F_4 folds enhanced the depressions and culminations in the F_3 axes. North-trending brittle-ductile shear zones were the youngest structures identified.*

Metamorphic assemblages in both the basement and Wollaston Supergroup rocks indicate moderate-pressure, granulite-facies conditions. Rare kyanite-bearing, cordierite restites suggest that these rocks passed through the kyanite stability field, either early on a prograde path or at extreme pressure and temperature, and that kyanite then remained metastable.

Basement to the Wollaston Supergroup comprises a volcano-plutonic succession that was intruded by ca. *2.70 Ga tonalite and 2.60 Ga granite plutons. Both the lower and upper successions in the Wollaston Supergroup are thought to be part of the <1.88 Ga foreland basin succession. These rocks were subjected to high-grade metamorphism, and D_1 and D_2 deformation prior to 1.83 Ga. A second metamorphic episode occurred at* ca. *1.82 to 1.81 Ga, the generally accepted age of peak metamorphism in the Trans-Hudson Orogen. D_3 deformation postdated this metamorphic episode. D_3 shearing developed under a dextral stress regime and was commonly focussed on the limbs of F_3 folds. One of these shear zones, the McRae Bay/Esker Lake fault, accommodated southeast-verging uplift, juxtaposing basement and the lower Wollaston succession with the upper Wollaston succession. Northwest-trending F_4 folds and north-trending, brittle-ductile faults were the final structures to develop.*

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Department of Geological Sciences, University of Saskatchewan, 114 Science Place, Saskatoon, SK S7N 5E2.
[3] Department of Geology, University of Regina, 3737 Wascana Parkway, Regina, SK S4S 0A2.

Preliminary U-Pb Ages for Archean Basement and Proterozoic Intrusion from the Northern Wollaston Lake area, Saskatchewan

C.T. Harper [1], N. Rayner [2], and C. Card [1]

Abstract

Two new U-Pb zircon age dates were obtained from igneous rocks along the northern part of Wollaston Lake. A garnetiferous felsic rock spatially associated with quartzite-psammite-amphibolite rocks previously correlated with the Hidden Bay Assemblage, but recently interpreted to be part of the Lower Sequence of the Wollaston Supergroup, yielded a preliminary U-Pb SHRIMP crystallization age of 2565 ±11 Ma indicating that the felsic rock represents a basement inlier. Garnet in this rock, together with its relationship to the presumed basal Wollaston Supergroup, suggests it may represent a zone of lateritic weathering. This age is consistent with other granitic basement rocks of the eastern Wollaston Domain and Peter Lake Domain. In addition, this rock contains two Paleoproterozoic zircon populations of 1812 ±7 Ma and 1776 ±7 Ma, which correspond to periods of pegmatite generation and metamorphism in the Trans-Hudson Orogeny. A weakly deformed monzodiorite that intruded deformed and metamorphosed Wollaston Supergroup rocks at Kiteley Bay, Klemmer Lake yielded a U-Pb TIMS crystallization age of 1829 ±1 Ma. This is a minimum age for early deformation event(s) and related high-grade metamorphism that were apparently responsible for producing the dominant northeast structural trend of the Wollaston Domain.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.

U-Pb SHRIMP Geochronology of a Felsic Volcanic Member in Upper Sequence Hurwitz Group Metasedimentary Rocks, Many Islands Lake, Northeast Saskatchewan

C.T. Harper [1] and W.J. Davis [2]

Abstract

New U-Pb zircon ages were obtained from a feldspar phyric rhyolite from Hurwitz Group rocks at Many Islands Lake in northeastern Saskatchewan and from granite and monzodiorite of the Wollaston Domain in northern Wollaston Lake. The sampled rhyolite is a rare rock type in the Hurwitz Group. It is associated with cherty quartzite, calcareous chert breccia, and felsic tuff breccia, which together overlie a thick pelitic succession and underlie a thinner pelite which is overlain by marble and calc-silicate rocks correlated with the Watterson Formation of the upper Hurwitz Group. Zircons from the rhyolite display morphological complexity and are considered to be primarily detrital with a slight possibility of some being primary volcanic zircons. U-Pb zircon SHRIMP ages range from 2.71 to 1.97 Ga with four prominent modes recognized; ca. *2.7, 2.6, 2.07, and 1.99 Ga. The two Archean modes are typical of the local basement rocks and could have been derived directly from the basement as the magma passed through, but more likely were detrital grains derived from the underlying pelitic rocks. The 2.07 Ga age mode is similar in age to volcanic rocks associated with rifting of the southeastern Hearne margin and initiation of deposition of the Wollaston Supergroup at* ca. *2.075 Ga. Although uplift and erosion of the Wollaston rift succession seems unlikely, it remains a possibility and perhaps there are, as yet unrecognized, rocks of that age that are more proximal to the Many Islands Lake area. The* ca. *1.99 Ga zircons are either: detrital/xenocrystic, in which case the 1.97±0.05 Ga youngest zircon represents a maximum age for deposition; or igneous in which case the weighted mean age of 1.99±0.01 Ga represents the time of crystallization and deposition of the cherty sedimentary units. These latter ages are in close agreement with the maximum depositional age of 1.96 Ga obtained for the Watterson Formation, the lowermost unit of the upper Hurwitz Group in Nunavut. Therefore, the cherty quartzite–rhyolite unit can be correlated with the upper Hurwitz. The underlying pelitic sequence, however, could be: 1) very similar in age to the felsic volcanic and, therefore, could be correlated with upper Hurwitz; 2) significantly older than upper Hurwitz Group, but younger than the Ameto Formation of the lower Hurwitz Group; or 3) correlated with the Ameto Formation and be approximately 150 million years older than the rhyolite. It is apparent that new formation or member designations are warranted for these rocks and that resolution of the age of the underlying pelitic sequence might be made by a detrital zircon study of the pelite.*

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.
[2] Geological Survey of Canada, Natural Resources Canada, 601 Booth Street, Ottawa, ON K1A 0E8.

Structural Investigations of Millrock Hill and the Hinge Zone of the Beaver Road Anticline, Creighton, Saskatchewan

D. Lewis [1], B. Lafrance [1], K. MacLachlan [2], and H. Gibson [1]

Abstract

Detailed mapping of Millrock Hill and the hinge zone of the Beaver Road Anticline at Creighton demonstrates that the northwest-trending Beaver Road Anticline folded an earlier bedding-parallel cleavage, has a moderate northeast-dipping, weak axial-planar cleavage, and has a fold axis that is coaxial with a southeast-trending, strong-stretching lineation expressed by elongate amygdules, pillows, and clasts in flows and volcaniclastic rocks. A series of south-dipping thrust faults cut across the hinge of the anticline. The thrust faults have been gently folded, suggesting further tightening of the Beaver Road Anticline after thrusting. The thrusts were reactivated as dextral shear zones and subsequently overprinted by a north-northeast–striking, shallowly southeast-dipping cleavage, and subvertical, northeast-striking shear zones. Late subvertical, north-south-striking brittle dextral faults cut across all other structures. Other thrust faults in the camp repeat stratigraphy, including the mine sequence, thus these findings about the relative timing of structural events, including reactivation of pre-existing faults, are important new contributions to understanding the geology of the Flin Flon–Creighton mining camp.

[1] Mineral Exploration Research Centre, Department of Earth Sciences, Laurentian University, 935 Ramsay Lake Road, Sudbury, ON P3E 2C6.
[2] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.

Peter Lake Domain Project: 1:100 000-scale Compilation of Bedrock Geology and Platinum-group Element Potential Maps

R.O. Maxeiner [1]

Abstract

A recently completed 100 000-scale bedrock geology compilation of the Peter Lake Domain illustrates a new understanding of the geological framework of the domain and has important implications for its platinum-group element (PGE) potential. The oldest components are >2630 Ma tonalitic to granodioritic basement and associated minor supracrustal rocks. They are cut by widespread 2580 to 2566 Ma granitic rocks, the Lueaza River Granitoid Suite, and the 2562 Ma gabbroic Swan River Complex. The first high-grade thermotectonic event overprinted the domain between 2550 to 2530 Ma and was accompanied by 2540 Ma monzonitic intrusions. Deposition of a conglomerate-feldspathic arenite-amphibolite succession, Sequence 1 of the Campbell River Group, is interpreted as coeval with the Courtenay Lake Group of the Wollaston Supergroup and corresponded with the onset of 2075 Ma rifting along the Hearne Craton margin. Deposition of a carbonaceous argillite-feldspathic wacke succession, Sequence 2 of the Campbell River Group, postdated the second regional high-grade metamorphic event and is speculated to coincide with or slightly predate emplacement of the 1917 to 1913 Ma monzonitic to leucogabbroic Porter Bay Complex. A low-grade metamorphic overprint coincided with emplacement of the Porter Bay Complex, which also marked the initiation of a subduction event under the Hearne Craton. This was followed by emplacement of an extensive Andean-type continental arc pluton, the 1865 to 1855 Ma Wathaman Batholith, comprising predominantly granitic to quartz monzonitic rocks and minor diorite and gabbro. The Peter Lake Domain remained high in the crust during the final regional thermotectonic event related to terminal collision and formation of the Trans-Hudson Orogen between 1820 to 1800 Ma, which was accompanied by open folding and shearing within the Peter Lake Domain.

Pilot ground gamma-ray spectrometric and whole rock geochemical studies illustrate the application of these tools in distinguishing between the lithologically similar Porter Bay and Swan River complexes. Lithological, textural, and metallogenic similarities between PGE occurrences in the Peter Lake Domain and those at the Lac des Iles mine and the Marathon deposit of the Coldwell Complex in northwestern Ontario are striking. As in the Ontario examples, disseminated sulphides in the Peter Lake Domain are magmatic in origin and closely associated with brecciated and 'varitextured' to pegmatitic gabbros, as well as with minor rhythmic cumulate layering.

[1] Northern Geological Survey Branch, Saskatchewan Industry and Resources, 2101 Scarth Street, Regina, SK S4P 2H9.